

TITLE: ELECTROPHORESIS SEPARATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is related to an electrophoresis separator,
5 and especially to such an electrophoresis separator by which
production of a sample is more convenient and the sample can
be connected to the whole device more easily, thereby the whole
electrophoresis separating engineering can be carried out
more smoothly and surely.

10 2. Description of the Prior Art

An electrophoresis method in biologic technology mainly
aims at separating and analysis of DNA, RNA and protein.
Macromolecules of DNA, RNA and protein are separated according
to the ratio of electric charge to mass, and the molecules are
15 driven by means of electric current to make the molecules float
on the gel of the substance. While in moving, the molecules
will be separated because of the differences of the electric
charges carried by the ion-natured ingredient and of the sizes
of these molecules themselves. The sample solution to be
20 separated and analyzed is dropped in the crevice of two
clamping carriers. As shown in Fig.1, a conventional carrier
(A) for receiving sample solution is made from two glass sheets
(A1) with a packing piece (A2) of proper thickness and a pair
of clamps (A3) to clamp them firm. Then the crevice between
25 the two glass-sheets (A1) are injected with gel (G) containing
tracing dyestuff and sealed. A comb-like board A41 and a

blocking member (A42) are provided in the upper and bottom openings respectively of the carrier (A) for fixing the shape of the gel. The electrophoresis separating engineering can be executed after the gel (G) is fixed and shaped, as shown in Fig. 2. Electric current is added to the gel (G), and stopped when stripes of the tracing dyestuff are moved over the length of the gel slice (G). A so-called molecule spectrogram will be formed at this time because of combination of the dyestuff with the protein or RNA on the gel in favor of observing and recording distribution of the sizes of the molecules in the sample solution.

Since characteristics of samples and the sizes of molecules are different, thickness of the gel slices used in the electrophoresis separating method will be different. There are three kinds of thickness 0.75 mm, 1.0 mm and 1.5 mm in general, and the thickness is determined by the packing piece (A2) between the two glass-sheets (A1) of the carrier (A); thereby, when in using the conventional carrier (A) to fix the sample solution, the glass sheets (A1) shall be dismantled frequently in order to change a packing piece slice (A2) of a different thickness for use. The breakage phenomenon of the glass sheets (A1) happens easily during the dismantling procedure and makes them unable to use again. The clamps (A3) only have the clamping function and are unable to position these two glass-sheets (A1) effectively. The effect of production of the sample will be affected by moving of these

two glass-sheets (A1) during the procedure of injecting and sealing the gel. Especially after completing injecting and sealing of the gel, the whole carrier (A) needs to be put on a receiving shelf to fix the carrier (A) for waiting for being
5 fixed and shaped of the gel. Thereby, the whole production procedure of the sample becomes complicated and is subjected to causing damage of the device and the sample.

As shown in Fig. 3, in order to eliminate the known defects resided in the abovementioned utilization of carrier and
10 clamps, a structure of frame (A5) is used directly to adjust the crevice of these two glass-sheets (A1). By adjusting the depth of screwing of a screw (A51), a result of adjusting the crevice between these two glass-sheets (A1) will be obtained directly. However, there are more than four points to be fixed
15 for every set of glass sheets (A1), it is impossible to adjust the depth of every screw (A51) in a fast and accurate way. Thus the crevice between the glass sheets (A1) will be uneven, and especially the glass sheets (A1) will be damaged because of over rotating of the screw (A51). And after completing the
20 action of injecting and sealing the gel, the whole carrier still needs to be put on a receiving shelf for waiting for being fixed and shaped of the gel. Besides, the conventional electrophoresis separator mainly uses an electrophoresis tank to do separation and analysis of the molecules, while the
25 abovementioned two structures of the carrier still need to be moved into the electrophoresis tank after production of the

sample of the carrier is completed. Then the carrier is positioned through a complicated fixing action, so it is still not as convenient in use as expected.

SUMMARY OF THE INVENTION

5 Accordingly, the electrophoresis separator of the present invention includes an electrophoresis tank and a receiving tank as the main body of the entire electrophoresis separator, and electrodes for driving electric current are provided and electric conducting liquid as an electric current passage is
10 formed separately in the electrophoresis tank and receiving tank. Wherein, the receiving tank is a case which can be installed directly in the electrophoresis tank, and is mainly used for placing therein carriers and is provided with two slots respectively on the two sides thereof to communicate
15 with the electrophoresis tank. One side of the carrier is provided with a notch matching with its corresponding slot. When the sample solution is dropped on the carrier, the latter can directly be inserted in the receiving tank. A blocking piece provided at the bottom of the receiving tank covers the
20 bottoms of the carriers and the crevices between the notches and the receiving tank, and blocking sheets are inserted into the slots and notches at the same time. The blocking sheets can be removed from the slots and notches after the gel filled in the carrier is fixed and shaped. Then the gel can contact
25 the electric conducting liquid in the electrophoresis tank through the slots and notches; the other ends of the gel slice

will contact the electric conducting liquid in the receiving tank through the upper openings of the carriers directly. When the electrodes in the electrophoresis tank and the receiving tank are in functioning, the electrons produced in the receiving tank by the electrodes can flow to the electrodes of the electrophoresis tank through the gel in the carriers. Thus electric current floating is resulted to cause an effect of molecule separation and analysis for the samples in the gel. And this is the prime object of the present invention.

Another object of the electrophoresis separator of the present invention is to connect two clamping sheets to form a structure of which positioning is sure for receiving a carrier which receives sample solution therein. In which, positioning pins and positioning holes are provided on the two clamping sheets respectively. There are protruding sockets all of a specific height provided on one of the two clamping sheets on the surface to be contacted with the other clamping sheet. When the two clamping sheets are abutted upon each other, the protruding sockets can form a crevice between the two. This will enable an operator to position the clamping sheets of the carrier promptly and get a thickness of the gel accurately after shaping.

The third object of the electrophoresis separator of the present invention is to provide clamping members on the clamping sheets of each carrier directly. When the two clamping sheets are abutted upon and positioned relative to

each other; the clamping members can be directly used to fix and clamp them.

A further object of the electrophoresis separator of the present invention is to provide elastic sheets sandwiched
5 between the two clamping sheets of each carrier in order to increase compactness between the two clamping sheets and help shaping of the gel so as to avoid gel spilling.

The present invention will be apparent after reading the detailed description of the preferred embodiment thereof in
10 reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic perspective view showing the structure of a sample carrier in a general gel electrophoresis method;

15 Fig. 2 is a schematic perspective view showing the way of generation of a molecule spectrogram in a general gel electrophoresis method;

Fig. 3 is a schematic perspective view showing the structure of another conventional sample carrier;

20 Fig. 4 is a schematic perspective view showing the whole structure of the device of the electrophoresis separator of the present invention;

Fig. 5 is a sectional view showing the structure of the whole device of the electrophoresis separator of the present
25 invention;

Fig. 6 is an exploded schematic sectional view showing the

status of floating of the electric current in the present invention;

Fig. 7 is a schematic perspective view showing the assembled status of a carrier with the receiving tank of the present invention;

Fig. 8 is a sectional view showing the assembled status of the carrier with the receiving tank of the present invention;

Fig. 9 is a sectional view showing the status of gel injecting and sealing in the present invention;

Fig. 10 is a sectional view showing the status of fixing and the shaping of the gel in the present invention;

Fig. 11 is a perspective view showing the appearance of the structure of a carrier of the present invention;

Fig. 12 is an analytic perspective view showing the structure of the carrier of the present invention;

Fig. 13 is a schematic perspective view showing the related connecting positions of blocking sheets in the carrier and the receiving tank of the present invention;

Fig. 14 is a schematic perspective view showing the status of connecting of the blocking sheets in the carrier and the receiving tank of the present invention;

Fig. 15 is a perspective view showing the appearance of the structure of the carrier of another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The electrophoresis separator of the present invention is shown in Fig. 4 and Fig. 5, the structure of the whole device is comprised of an electrophoresis tank 11 and a receiving tank 4 as the main body. The electrodes for driving the electric current are provided in the electrophoresis tank 11 and the receiving tank 4 separately. A cathode 21 and an anode 22 are provided simultaneously on the top of the receiving tank 4 in the structure of the embodiment shown. And the electrophoresis tank 11 and the receiving tank 4 are filled with electric conducting liquid 24 to form an electric current passage. Besides, the anode 21 and the cathode 22 are connected to the electric conducting liquid 24 in the electrophoresis tank 11 and the receiving tank 4 via conductors 23. Carriers 3 each for receiving a sample are immersed in the electric conducting liquid 24 of the receiving tank 4, and an upper lid 12 is used to cover the entire reaction device. An electrode connector 121 is provided on the upper lid 12 in favor of supplying the electric current for the electrodes.

With regard to the receiving tank 4, it is a case and can be installed directly in the electrophoresis tank 11. The bottom of the electrophoresis tank 11 is provided with two positioning members 111 to matchably fix the receiving tank 4. A slot 41 in communicating with the electrophoresis tank 11 is formed on each side of the receiving tank 4. Each carrier 3 is made from two clamping sheets. The clamping sheets are

divided into a first clamping sheet 31 and a second clamping sheet 32 according to their respective contours. The bottom of the first clamping sheet 31 forms a notch 323 correspondingly to one of the slots 41. As shown in Fig. 7 and Fig. 8, there are positioning grooves 42 provided in the receiving tank 4 to position the carriers 3, and press fixers 43 are provided on the top of the receiving tank 4 to fix the carriers 3. After the sample solution is dropped on the carriers 3, the latter can be inserted in the receiving tank 4. A bottom blocking piece 44 provided at the bottom of the receiving tank 4 will directly cover the bottom of the carriers 3 and the crevices between the notches 323 and the receiving tank 4. And blocking sheets 45 are inserted into the slots and notches at the same time. Then as shown in Fig. 9, the gel (G) is injected and sealed between first clamping sheets 31 and second clamping sheets 32 of the carriers 3 and a comb-like board A41 is provided on the upper opening of each carrier 3 to help shaping of the gel (G).

After the gel (G) filled in the carriers 3 is fixed and shaped, the blocking sheets 45 at the slots 41 and the comb-like boards A41 can be removed to become the status shown in Fig.10. Again as shown in Fig 5 and Fig. 6, the whole receiving tank 4 is placed in the electrophoresis tank 11, and the electric conducting liquid 24 is added to the receiving tank 4 in order to make the gel slices (G) contact the electric conducting liquid 24 in the electrophoresis tank through the

slots 41. The other ends of the gel slices (G) directly contact the electric conducting liquid 24 in the receiving tank 4 through the upper openings of the carriers 3. And positioning members 111 at the bottom of the electrophoresis tank 11 can be installed correspondingly beneath the slots 41 at the bottom of the receiving tank 4 to function as a reminder for the operator to remove the blocking sheets. While the electrodes are activated in the electrophoresis tank 11 and the receiving tank 4, electrons produced by an anode 21 in the receiving tank 4 can be drifted to a cathode 22 in the electrophoresis tank 11 through the gel (G) of the carrier 3. Thus a result of electric current floating is formed and this will cause an effect of molecule separation and analysis of the sample in the gel (G).

Referring to Fig. 11 and Fig. 12 at the same time, the carriers 3 of the present invention are formed each by sure positioning of the first clamping sheet 31 and the second clamping sheet 32 to form a structure to receive the sample solution. There are positioning holes 311 and positioning pins 321 provided on the first and second clamping sheets 31, 32 respectively. There are protruding sockets 312 all of a specific height provided on each of the first clamping sheets 31 on the surface to be contacted with one of the second clamping sheets 32. When the two clamping sheets are abutted upon each other, the protruding sockets 312 can form a crevice between the two. This will enable an operator to position the

first clamping sheet and the second clamping sheet 31, 32 of each carrier 3 promptly and get a thickness of the gel accurately after shaping by means of the positioning holes 311 and positioning pins 321. Besides, there are clamping members 5 322 formed on the second clamping sheet 32 of the carrier 3 directly, so that when the first and second clamping sheets 31, 32 are abutted upon and positioned relative to each other; the clamping members 322 can be directly used to fixedly clamp the first and second clamping sheets 31, 32 to assure firmness 10 of the structure. Furthermore, an elastic sheet 33 can be sandwiched between each pair of the first and second clamping sheets 31, 32 of the carriers 3 in order to increase compactness between the two clamping sheets and help shaping of the gel so as to avoid gel spilling.

15 As shown in Fig 13 and Fig 14, the first and second clamping sheets 31, 32 of the carriers 3 are ejection shaped of plastic material, they have the advantage of not being fragile; this will make it more convenient to design the contour of the clamping sheets. As shown in the figures, a notch 323 formed 20 at the lateral of each carrier 3 can be provided at the bottom of a first clamping sheet 31 directly. And two fitting-in portions 441 are provided on the bottom blocking piece 44 to match and fit in the notches 323. An opening 442 is provided at each fitting-in portion 441 for insertion of the blocking 25 sheet 45. So, when the first and the second clamping sheets 31, 32 are abutted upon each other, a notch 323 of the carrier

3 will be formed naturally. And when the carrier 3 is installed in the receiving tank 4, a tight clinging effect will be formed among the bottom blocking piece 44, the blocking sheet 45 and the carrier 3 in favor of preventing leakage of the gel (G).

5 In particular, an outwardly bent portion 313 can be provided on the top end of each first clamping sheet 31 for the convenience of injecting the gel (G) and the dismantling of the two clamping sheets afterwards. Moreover, a convex grasp portion 324 can be provided on the top end of one of the
10 clamping sheets (the second clamping sheet 32 as in the drawing) of the carriers 3 as shown in Fig. 15. And a finger hole 325 is provided on the grasp portion 324 in order that the operator grasps a carrier 3 to pull out the carrier 3 from the receiving tank 4 smoothly or to place the carrier 3 in conveniently.

15 The electrophoresis separator of the present invention is provided with one slot on each side of the receiving tank to communicate with the electrophoresis tank. One side of each carrier is provided with a notch in corresponding to one of the slots, so that the gel can contact the electric conducting
20 liquid in the electrophoresis tank through the slot. And the other ends of the gel will contact the electric conducting liquid in the receiving tank through the upper openings of the carriers directly. When the electrodes in the electrophoresis tank and the receiving tank are activated, the electrons
25 produced in the receiving tank by the electrodes can be drifted to the electrodes of the electrophoresis tank through the gel

on the carriers. Thus electric current floating is resulted
to cause an effect of molecule separation and analysis of the
sample in the gel, and a device of a practicable preferred
structure of the electrophoresis separating engineering is
5 provided accordingly.

Having thus described my invention, what I claim as new
and desire to be secured by Letters Patent of the United States
are:

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